OXYGEN EFFECT ON THE SURFACE CONDUCTIVITY OF N-TYPE SULFUR-DOPED DIAMOND

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Recently there has been much interest in the phenomenon of surface conductivity of diamond films and the effect of various adsorbates on this conductivity. Specifically, it has been found that oxidizing conditions tend to increase the surface conductivity of boron-doped diamond films and reducing conditions tend to decrease the conductivity. Another example an oxygen saturated solution. One possible mechanism for the increased conductivity that results from the presence of an oxidant involves the transfer of electrons from the bulk of the p-type boron doped diamond to the adsorbate, which effectively increases the number of p-type charge carriers (holes). [i],[ii] This increase in conductivity can be used to as a way to sense the presence of an oxidant such as oxygen. Thus far, this phenomenon has only been reported for p-type diamond films.[iii] Recently, we have found in our laboratory that a similar phenomenon also occurs on n-type diamond films, such as sulfur-doped films. Sulfur is a deep donor in diamond.[iv], [v] In this case, however when the electron is transferred from the diamond to the oxidant, the number of n-type charge carriers (electrons) is decreased, and the surface conductivity decreases. This also results in decreases in the currents for oxygen evolution and hydrogen evolution from an aqueous solution. We have used the latter observation as a means of measuring the concentration of oxygen dissolved in aqueous solutions. There is a rough correlation between the electrochemical behavior and the sulfur doping level for a series of nanocrystalline films prepared as described previously [vi]. In particular for high doping levels, the decrease in current upon exposure of the solution to air is small, whereas for low doping levels the relative decrease is large.

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